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Narayan, Laxmi

Government Post Graduate College, Mahendergarh

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HEALTH DISPARITIES IN HARYANA
- A DISTRICT LEVEL ANALYSIS

Laxmi Narayan

Assistant Professor,
Government Post Graduate College,
Mahendergarh, Haryana,
India, 123029

Email: laxmi_narayan70@yahoo.com

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Abstract

Using principal component analysis(PCA) the paper construct a composite health index for each district for comparing the health status in various districts of Haryana. The health status was measured by various indicators covering three aspects of health, viz., health outcome indicators, health infrastructure indicators and access to and uses of health facilities. We found wide inter-district disparities in various health indicators. Health is not sole responsibilities of state and public in general uses both public and private health services. The private health care has grown significantly Hence, the paper also compared health outcome by comparing Infant Mortality rates and Child Mortality rate (CMR) across district of the state. We found that some districts scoring high on health infrastructure performed poorly on uses of health facilities and vice-versa.

Keywords: **Haryana, Health Indicators, Factor Analysis, Composite Health Indicator**

JEL Codes: **I10**

HEALTH DISPARITIES IN HARYANA - A DISTRICT LEVEL ANALYSIS

1. INTRODUCTION

With impressive economic growth, one of the highest per capita income index, sound industrial infrastructure, strong manufacturing base, advanced agriculture sector and vibrant service sector, Haryana is one of the highly economically flourishing and industrialised states of India. Today, it enjoys the unique distinction of having provided electricity, metalled roads and potable drinking water to all its villages. Haryana has also done very well in terms of development but its health and education indicators are less than satisfactory specifically in view of its economic prosperity. Moreover there are wide range of intra-state regional disparities or inter-districts imbalances in economic & social indicators as well in the sectors of agriculture, industries, education, health, water supply, sanitation and social services. There exists wide inter-district disparities in terms of per capita income as the ratio of richest district per capita income to the poorest district per capita income is 6.97 implying high income inequalities. The ratio of income of the three richest districts to three poorest districts is 4.38 which confirms prevalence of significant inter-district disparities in the state(Narayan, 2011).

The role of human capital is almost universally regarded as being indispensable to the engine of economic growth. Recent literature starting from the work of Barro & Sala(1995) and Barro(1996) link between health and economic growth has gained importance. The studies by Arora (2001), Mayer (2001), Sachs (2003), Baldacci (2004) Fogel (2004), Bloom & Canning (2005), Finlay (2007), Ashraf, Lester & Weil (2008) and Bloom & Fink(2013) reported a strong positive relationship between health and economic growth and prosperity. Improvement in the health status of the population has been one of the major thrust areas in social development programmes of the State. At present, health services in Haryana are being provided through a network of 57 Hospitals, 112 Community Health Centers, 485 Primary Health Centers, 2,630 Sub-Centers, 7 Trauma Centers, 37 Urban and Rural dispensaries, 90 Urban RCH Centers and 473 Delivery huts. In addition, 11 Polyclinics, 4 Dispensaries and 11 Urban Health Centers have been operationalised (Economic Survey of Haryana, 2014-15). But the delivery of the services is not uniform across regions and districts. Not only there are inter-district disparities in delivery of health services, there are disparities in health outcomes also. Given this background, it is interesting to analyse health indicators and inter-district

variations in health indicators in Haryana. The main objectives of the paper is to undertake a comparative analysis of inter-district disparities in health infrastructure by comparing availability of health staff, hospitals and services delivery by health staff. Health is not sole responsibilities of state and public in general uses both public and private health services. The private health care has grown significantly Hence, the paper also compared health outcome by comparing Infant Mortality rates and Child Mortality rate (CMR) across district of the state.

2. DATA AND METHODOLOGY

The data for the study are obtained/compiled from 'Statistical Abstract of Haryana-2013-14' and 'District Level Household and Facility Survey-2007-08: Haryana'. The paper also uses data from Sample Registration System(SRS) Bulletin and Civil Registration System(CRS) Report published by Vital Statistics Division of Registrar General, India. The infrastructure related health statistics are also used from Rural Health Statistics (RHS) Bulletin published by Ministry of Health & Family Welfare, Government of India. Collated data from planning commission table for Chairman is also used for the purpose. The data has been examined at district level and the latest available data has been used. The data is represented through tables. Principal Component Analysis has been used to group the district with similar characteristics. The study conducted Principal Component analysis using SPSS 19.0 with varimax rotation with twelve variables. The component scores of extracted factors are combined using their explaining power to form a weighted composite health indicator.

3. INTER-DISTRICT DISPARITIES IN HEALTH STATUS

Health is a multi-dimensional concept, hence, there is no single standard measurement of health status for population groups. Judgments regarding the level of health of a particular population are usually made by comparing one population to another, or by studying the trends in a health indicator within a population over time. Due to simplicity, and easy availability of data, mortality rates are usually used as measures of health. Key health indicator based on mortality rates are (a) Life expectancy and health-adjusted life expectancy [HALE] (b) Maternal Mortality Ratio [MMR] (c) Infant Mortality Rate [IMR] (d) Neo-natal Mortality Rate [NMR] (e) Child Mortality Rate [CMR]. District level secondary data was only available on IMR and CMR, hence we could include these two indicators only. There exists wide inter-district disparities in health in Haryana.

Table-1: Indicators of Health in Districts of Haryana

	Infant Mortality Rate	Child Mortality Rate	Full ANC*	Inst delivery	Safe delivery	Full Immunization**	Area covered per institution in Kms	No. of Doctors	Total indoor patients treated	Institutes per lakh of population	Beds per lakh	Total medical staff
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Ambala	32	29	17.4	55.4	62.9	79.1	12	64	44240	11	47	770
Bhiwani	44	48	8.9	35.7	44.8	58.4	17	145	59060	17	59	1229
Faridabad	37	43	9.3	39.1	42.7	46.4	07	42	60166	06	33	374
Fatehabad	50	53	9.5	48.6	58.1	62.8	19	78	34738	14	28	485
Gurgaon	47	52	27.5	52.3	56.8	70.5	13	69	43077	09	20	583
Hisar	41	45	10.4	48.6	54.5	55.8	15	121	47277	14	45	984
Jhajjar	42	45	16.2	48.0	57.9	64.8	12	72	24756	15	35	761
Jind	48	54	9.7	42.1	48.3	55.4	13	46	32084	14	37	897
Kaithal	48	50	21.1	48.0	57.4	72.5	13	53	26718	15	28	445
Karnal	39	41	16.6	51.3	57.1	75.2	14	95	47514	12	31	715
Kurukshetra	44	35	11.8	64.2	67.8	67.8	11	58	31418	14	32	506
Mahendragarh	45	54	9.1	56.8	65.1	67.7	14	56	32490	14	35	1032
Mewat	52	59	1.9	14.8	16.3	11.0	14	48	25152	11	16	449
Panchkula	34	35	19.1	64.3	67.8	78.1	12	138	39045	14	55	664
Panipat	45	43	6.2	39.0	48.4	57.0	11	62	25277	10	26	383
Rewari	42	47	20.6	65.0	73.5	67.3	12	32	26428	15	38	84
Rohtak	38	43	27.5	52.8	58.9	75.7	11	80	116965	14	159	642
Sirsa	41	43	17.8	53.5	69.5	61.3	23	83	32497	14	28	527
Sonipat	35	43	14.9	53.7	61.0	73.0	10	101	31607	14	27	745
Yamunanagar	35	36	20.8	52.3	58.4	70.0	12	95	40481	13	35	662

Source: *Column 2&3*-Rajan et. al.(2008); *Column 4 to Column 7* – DLHS-3;
Column 8 to Column 13 - Compiled from Statistical Abstract of Haryana

Note: * Full Ante Natal Checkup (ANC) consists of at least three visits for antenatal check-up, at least one TT injection received and 100+ IFA tablets/ syrup consumed.

****** Full immunization comprises BCG, three doses of DPT, three doses of Polio (excluding Polio 0) and measles.

The Principal Component analysis was conducted using SPSS 19.0 with varimax rotation including 12 variables namely (i) Infant Mortality Rate (ii) Child Mortality Rate (iii) percentage of pregnant women going for full ANC (iv) Percentage of Institutional Delivery (v) Percentage of Safe Delivery (vi) Percentage of Children having Full Immunization (vii) Area Covered per Institute in Sq Km (viii) Numbers of Doctors (ix) total indoor patients treated (x) Institutions per Lakh of Population (xi) Beds per Lakh of Population and (xii)

Total Medical Staff. Data on all the selected indicators are presented in Table-1. In order to understand the disparities in the selected indicators across various districts of Haryana, we computed range, standard deviation and variance for the indicators and the results are presented in table-2.

Table-2. Descriptive Statistics

	Min	Max	Range	S.D.	C.O.V
Infant Mortality Rate (IMR)	32	52	20	5.6	13.4
Child Mortality Rate (CMR)	29	59	30	7.5	16.8
Full ANC	1.9	27.5	25.6	6.9	46.2
Institutional Delivery	14.8	65	50.2	11.5	23.3
Safe delivery	16.3	73.5	57.2	12.4	22.1
Full Immunization	11	79.1	68.1	15.1	23.7
Area covered per institution in Kms	7	23	16	3.4	25.7
No. of Doctors	32	145	113	31.2	40.5
Total indoor patients treated	24.8	117.0	92.2	20.8	50.6
Institutes per lakh of population	6	17	11	2.5	19.3
Beds per lakh	16	159	143	29.8	73.2
Total medical staff	84	1229	1145	262.8	40.6

The paper used sophisticated technique of Principal Component Analysis(PCA). The result of PCA analysis are presented and discussed in subsequent paragraphs. The method of Principal component is a special case of the more general method of Factor Analysis. The aim of the method of Principal Component Analysis is the construction of a set of variables P_i, called Principal Component (I = 1,2,……k) out of a set of variables, 1,2,3……k). Each Principal component is a linear combination of the X's;

$$P_1 = a_{11}x_1 + a_{12}x_2 + \ldots\ldots\ldots\ldots + a_{1k}x_k$$
$$P_2 = a_{21}x_1 + a_{22}x_2 + \ldots\ldots\ldots\ldots + a_{2k}x_k \ldots$$
$$\ldots$$
$$P_k = a_{k1}x_1 + a_{k2}x_2 + \ldots\ldots\ldots\ldots + a_{kk}x_k$$

The method of principal component can be applied by using the original values of the Xj's or the standardized variables Zj defined by -

$$Z_j = (X_j - X) / \sigma x_j$$

The coefficients aij's are called loading of the principal component which are so chosen that the newly created variables, called principal components, satisfy the following two conditions – (i) Principal components are orthogonal (uncorrelated), (ii) the first principal component has a larger variance as possible. The second principal component is then chosen in such a way that it absorbs the maximum of the remaining variations in X's after allowing for the variation accounted by the first principal component and so on. In this

procedure the data matrix is transformed into a new set of uncorrelated principal components which account as much of the variation as possible in descending order. The analysis was performed with a view to construct a composite index of wealth for the districts of Haryana.

Initially the PCA was performed including including all 12 variables for the study but the value of KMO was only 0.498, hence by inspecting communalities scores, the variable with lowest communality area covered per institution in Kms(0.645) was removed and PCA was re-run. The KMO statistics improved to 0.614 and Berlet test of sphericity also indicated that PCA can be performed on the dataset. Hence, in final analysis only 11 variables were included. The Principal Component analysis was conducted using SPSS 19.0 with varimax rotation including 11 variables namely (i) Infant Mortality Rate (ii) Child Mortality Rate (iii) percentage of pregnant women going for full ANC (iv) Percentage of Institutional Delivery (v) Percentage of Safe Delivery (vi) Percentage of Children having Full Immunization (vii) Numbers of Doctors (viii) total indoor patients treated (ix) Institutions per Lakh of Population (x) Beds per Lakh of Population and (xi) Total Medical Staff. As per methodology explained earlier, factors with eigenvalue more than one were extracted. The four components have been extracted and they explained 77.8% of the total variance. The eigenvalues and cumulative variance are presented in table-3.

Table 3. Total Variance Explained

Compo-nents	Initial Eigen values			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.522	41.11	41.11	3.522	32.02	32.02
2	2.106	19.15	60.26	2.108	19.17	51.19
3	1.668	15.16	75.42	1.979	18.00	69.18
4	1.285	11.68	87.11	1.972	17.93	87.11
5	0.483	4.39	91.50			
6	0.420	3.82	95.32			
7	0.224	2.03	97.35			
8	0.149	1.35	98.71			
9	0.081	0.74	99.45			
10	0.037	0.34	99.78			
11	.024	0.22	100.00			

Source: Compiled from SPSS output.

Table-4 presents the loadings of each of the three components on the selected variables in the original datasets. It is observed that the first factor has high positive

correlation with Percentage of Children having Full Immunization, Percentage of Institutional Delivery, Percentage of Safe Delivery and Percentage of pregnant women having gone full ANC. These all indicators represent uses of health facilities, hence it can be named as access to health infrastructure. This factor explain 32.02 percent of variance. The second factor is highly correlated with Number of Indoor Patient Treated and beds per lakh of Population. This component, thus relates to indoor treatment infrastructure. Second factor explains 19.17 percent variance. The third factor is highly correlated with IMR and CMR can be named as health outcome indicator. The fourth factor is correlated with Number of Doctors Available, Strength of Medical Staff in the District and Institutions per Lakh of Population. These indicators can be renamed as health physical infrastructure indicator.

Table 4. Rotated Component Matrix

Extraction Method: *Principal Component Analysis*
Rotation Method: *Varimax with Kaiser Normalization*.

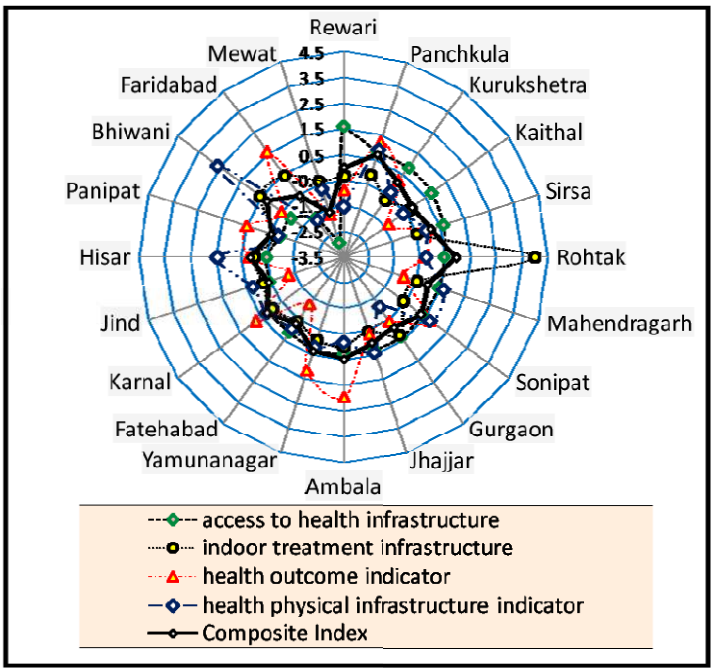
	Component				Communality
	1	2	3	4	
Percentage of Safe delivery	0.957	--	--	--	0.947
Percentage Institutional Delivery	0.934	--	--	--	0.929
Percentage Full Immunization	0.860	--	--	--	0.880
Percentage of Full ANC	0.696	--	--	--	0.749
Total indoor patients treated	--	0.960	--	--	0.962
Beds per lakh of Population	--	0.930	--	--	0.923
Infant Mortality Rate (IMR)	--	--	0.859	--	0.904
Child Mortality Rate (CMR)	--	--	0.849	--	0.876
Total medical staff	--	--	--	0.872	0.784
No. of Doctors	--	--	--	0.826	0.792
Institutions per lakh of Population	--	--	--	0.638	0.834
Variance Explained	32.02	19.17	18.00	17.93	

Source: Compiled from SPSS output.
Note: 1. *Rotation converged in 5 iterations*.
2. Factor Loadings < 0.5 are omitted.

Table-5 depicts scores of each component with overall scores for the 20 observations. The scores of individual components indicate the direction and extent to which an observation is associated with the respective components.. In some cases, the scores work out to be positive, while in the remaining others they are negative. A high and positive score indicate that a particular district is more developed than others with lower scores. The data presented in table-10 reveals that on the first component representing '*uses of and access to the health facilities*' the highest score is attained by Rewari(1.596) followed by Panchkula (0.851), Kurukshetra (0.847) Kaithal(0.774) and Ambala (0.885) while lowest score is of Mewat(-2.906) followed by Faridabad (-1.636), Bhiwani (-0.926), Panipat(-0.874) and Hisar(-0.696).

On the second component representing indoor treatment infrastructure Rohtak, Bhiwani, Faridabad and Gurgoan scored higher as these districts has higher number of treatment facilities available in these districts whereas Kurukshetra, Panipat, Sonipat and Mahendragarh scored lower in this parameter. On third component named health outcome indicator Ambala, Faridabad, Panchkula and Yamunanagar performed better and Mewat, Kaithal, Fatehabad and Jind performed poorly among districts of Haryana. On the fourth component representing health infrastructure facilities Bhiwani scored highest and Faridabad scored lowest. Alongwith Bhiwani, Hisar, Panchkula and Sonipat performed better on this component whereas Faridabad Rewari Gurgaon Panipat Mewat performed lower in this component. Component scores are plotted and presented in Chart-1 which reveals significant differences in the scores obtained by districts on all four factors.

Chart-1. Plotting of Component Scores



Source: Based on Data presented in Table-5

Table-5: Component Score

District	Component Score				Composite Score
	C_1	C_2	C_3	C_4	
Ambala	0.280 *(11)*	-0.028 *(6)*	1.969 *(1)*	-0.189 *(12)*	0.465 *(3)*
Bhiwani	-0.926 *(18)*	0.557 *(2)*	-0.491 *(14)*	2.611 *(1)*	0.218 *(7)*
Faridabad	-1.636 *(19)*	0.441 *(3)*	1.585 *(2)*	-1.708 *(20)*	-0.529 *(18)*
Fatehabad	0.132 *(13)*	-0.406 *(14)*	-1.210 *(17)*	-0.063 *(10)*	-0.304 *(16)*
Gurgaon	0.334 *(9)*	0.265 *(4)*	-0.401 *(13)*	-1.097 *(18)*	-0.127 *(14)*
Hisar	-0.481 *(16)*	-0.012 *(5)*	0.227 *(8)*	1.416 *(2)*	0.159 *(8)*
Jhajjar	0.297 *(10)*	-0.457 *(15)*	-0.340 *(11)*	0.393 *(6)*	0.019 *(11)*
Jind	-0.444 *(15)*	-0.181 *(10)*	-1.239 *(18)*	0.250 *(7)*	-0.408 *(17)*
Kaithal	0.774 *(4)*	-0.230 *(11)*	-1.305 *(19)*	-0.579 *(15)*	-0.155 *(15)*
Karnal	0.078 *(14)*	-0.041 *(7)*	0.758 *(5)*	0.228 *(8)*	0.223 *(6)*
Kurukshetra	0.847 *(3)*	-0.743 *(20)*	0.188 *(9)*	-0.335 *(14)*	0.118 *(9)*
Mahendragarh	0.417 *(7)*	-0.482 *(17)*	-1.007 *(16)*	0.618 *(5)*	-0.034 *(13)*

Mewat	-2.906 *(20)*	-0.359 *(13)*	-1.75 *(20)*	-0.694 *(16)*	-1.512 *(20)*
Panchkula	0.851 *(2)*	-0.117 *(9)*	1.260 *(3)*	0.929 *(3)*	0.739 *(2)*
Panipat	-0.874 *(17)*	-0.691*(19)*	0.461 *(7)*	-0.797 *(17)*	-0.542 *(19)*
Rewari	1.596 *(1)*	-0.322 *(12)*	-0.892 *(15)*	-1.529 *(19)*	0.017 *(12)*
Rohtak	0.442 *(6)*	3.983 *(1)*	-0.354 *(12)*	-0.266 *(13*)	0.911 *(1)*
Sirsa	0.622 *(5)*	-0.473 *(16)*	0.003 *(10)*	-0.080 *(11)*	0.109 *(10)*
Sonipat	0.337 *(8)*	-0.597 *(18)*	0.709 *(6)*	0.701 *(4)*	0.283 *(5)*
Yamunanagar	0.260 *(12)*	-0.106 *(8)*	1.155 *(4)*	0.190 *(9)*	0.350 *(4)*

Source: Compiled from SPSS output

Note: 1. Figure in parenthesis are their respective rank.

2.The three intermediate composites(C1, C2 and C3) are aggregated by assigning a weight to each one of them equal to the proportion of the explained variance in the data set. That is 0.368 for C_1 [3.52/ (3.52+2.11+1.98+1.97], 0.220 for C_2 [2.11/(3.52+2.11+1.98+1.97]; 0.207 for C_3[1.98/(3.52+2.11+1.98+1.97] and 0.206 for C_4 [1.97/ (3.52+2.11+1.98+ 1.97]. Refer OECD (2008) for methodology.

The composite health indicator using factor analysis is constructed and presented in table-5. Last column of the table shows that Rohtak stands first, Panchkula second and Ambala third on Composite Health Indicator whereas Mewat ranked last followed by Panipat and Faridabad. Classification of districts based on the composite health indicator are presented in table-6. On the basis of overall score, the districts are regionalized in following five categories.

Table-6.
Classification of Districts according to Composite Score

Category	**No. of Districts**	**Name of Districts (in order of decreasing score)**
Very High (above 0.5)	02	Rohtak and Panchkula
High (0.25 to 0.50)	03	Ambala, Yamunanagar and Sonipat
Medium (0.0 to 0.25)	07	Karnal, Bhiwani, Hisar, Kurukshetra, Sirsa, Jhajjar and Rewari
Low (-0.5 to 0.0)	04	Mahendragarh, Gurgaon, Kaithal and Fatehabad
Very Low (Below -0.5)	04	Jind, Faridabad, Panipat and Mewat

Source: *Compiled by from table-5.*

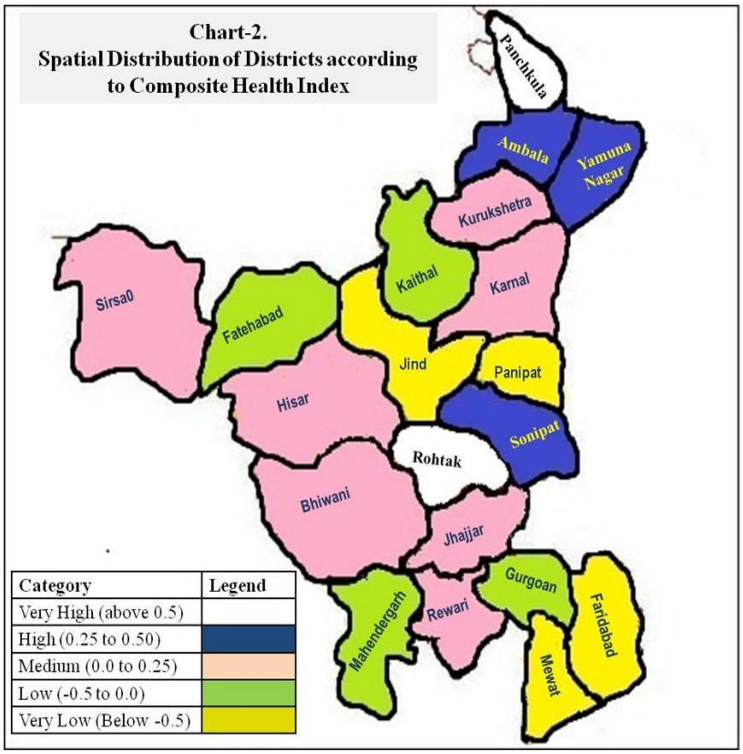
The spatial distribution of districts based on composite health index are shown in Chart-2. It is evident from the Chart that Northern Districts of the states are better placed in terms of health as Panchkula, Ambala and Yamunanagar have high scores on composite health indicator. The south-east Haryana performed poor as districts of Faridabad (including Palwal) and Mewat scored very poor on composite health indicator. Rohtak scored high on composite health indicator mainly on the strength of PGIMS, Rohtak as it has huge advantage

vis-à-vis other districts on many indicators such as number of beds available and number of indoor patient treated.

4. SUMMARY AND POLICY IMPLICATIONS

In this paper an attempt was made to assess the extent of inter district disparities in Haryana in terms of health indicators. The health status was measured by various indicators covering three aspects of health, viz., health outcome indicators, health infrastructure indicators and access to and uses of health facilities. Paper found wide inter-district disparities in various health indicators. For example the highest rate of IMR is 56.2 percent more than the lowest IMR and in case of urban female IMR it is more than 104 percent. In case of full antenatal check up the percentage coverage rages from 1.9 percent to 27.5 percent. The coefficient of variance of various health indicators clearly shows wide dispersion in health indicators. The composite score by PCA shows similarities based on the geographical location of the districts. The extraction of factor scores and their district-wise ranking reveals some interesting results. We found that some districts scoring high on health infrastructure performed poorly on uses of health facilities. For example Bhiwani scoring highest on availability of health infrastructure ranked last but two on access to and uses of health facilities. Same is the case with Hisar, scoring high on public health infrastructure indicator and poor on uses of public health facilities. This indicate that public in large is not availing the available public health infrastructure. Similarly some of the districts scoring very low on health infrastructure scores very high on access to and uses of health facilities. For example Rewari ranked first in access to and uses of health facilities ranked 18th on public health infrastructure indicator. Same is the case with Kurukshetra and

Chart-2.
Spatial Distribution of Districts according to Composite Health Index



Source: *Plotted from data presented in Table-5.*

Kaithal. This indicates that either the residents of these districts are making better uses of available public health facilities or they are availing private healthcare facilities. Again The reason could either be the attitude of public health staff or cultural factors. Hence, we can safely conclude that merely placing public infrastructure does not ensure proper maternal and child health care, the emphasis should be on their proper and efficient uses. The lack of general health awareness may be a obstacle in using the facilities in particular maternal health care and reproductive and child health care facilities.

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